

A Study on the Effective Teaching Method for Bridge Resource Management in Korea

Lan Kim Thi Thu*[†] · Jung-Sik Jeong** · Jae-Yong Jeong**

* Graduate School of Mokpo National Maritime University, Mokpo, 530-729, Korea

** Division of International Maritime International Transportation Science, Mokpo, 530-729, Korea

선교자원관리의 효과적인 교육방법에 관한 연구

김티투란*[†] · 정중식** · 정재용**

* 목포해양대학교 대학원, ** 목포해양대학교 국제해사수송과학부

Abstract : In 2010 the Manila Amendments established the highest practicable standards for officers and engineers. This amendments includes knowledge, understanding, skills, and proficiency required for a deck officer in terms of the BRM (Bridge Resource Management) to reduce human errors, stated in the International Convention on Standards of Training, Cerification and Watchkeeping for Seafarers (STCW). This paper proposes a proper direction to improve BRM education program in Korea. In relation to the BRM program, its contents and education method were analyzed through the satisfactions survey for cadets and the experienced officers . As a consequence, this research gives several suggestions to improve the current BRM course.

Key Words : Marine accident, Human error, Maritime education, IMO model course, Bridge resource management

요 약 : 2010년 STCW 마닐라 수정안은 항해사에게 선교자원관리에 대한 지식 및 기능에 관한 해기능력을 강제적인 사항으로 포함하고 있다. 본 연구는 선교자원관리의 관점에서 STCW 2010 개정안에 토대를 둔 국내 교육 프로그램의 적절한 방향을 제안한다. 선교자원관리 프로그램과 관련하여 그 내용 및 교육방법이 국내 교육프로그램에 대한 설문조사를 통하여 분석되었다. 그 결과로서 본 연구는 현재의 선교자원관리 교육 프로그램을 개선하기 위한 몇 가지 제안을 한다.

핵심용어 : 해양사고, 인적에러, 해기교육, IMO 모델코스, 선교자원관리

1. Introduction

Bridge Resource Management (BRM) education according to Adams(2010) is “to let a trainee take up attitudes of using and coordinating all the skills knowledge, experience and resources available to the bridge team to accomplish or achieve the established goals of safety and efficiency of the passage”.

The Manila Conference of Parties to the International Convention on Standards of Training Certification and Watchkeeping for Seafarers (STCW), 1978, established the highest practical standards of training, education and competence for officers in charge of a navigational watch on ships of 500 gross

tons or more. The 2010 Manila Amendments include knowledge, understanding, skills and proficiency required for deck officers in terms of the BRM as an effective means of reducing human errors(IMO, 2010).

Recently, there have been several approaches with respect to the BRM, such as: “A Research Agenda in Maritime Crew Resource Management”(Barnett et al., 2003), and “The Role of Human Factors and Bridge Resource Management in Reducing Maritime Casualties”(Yousefi and Seyedjavadin, 2012).

Aside from these papers, there are general topics written related to BRM, like: “The Importance of effective communication, International Seminar on Maritime English(Winbow, 2002)”, and “Cooperative learning and teamwork effectiveness impacts of education period on cadets(Asyali et al., 2006)”. These researches had

[†] Corresponding Author : consokhong@naver.com, 010-9606-0904

already suggested effectiveness of BRM to maritime safety. However, no solution to improve the BRM training program were offered.

This paper aims at improving the BRM teaching in terms of educational program for cadets and mariners. A questionnaire to the cadets and the experienced mariners was conducted to measure the effectiveness and improvement of BRM training program. This paper surveyed respondents' satisfaction level related to the contemporary BRM course in Korea. Through survey results, we offer suggestions for a proper direction on an effective BRM education program.

2. Bridge Resource Management Program

2.1 The STCW Requirements for BRM

The minimum requirement of the 2010 STCW amendment regarding the BRM education program include the following:

Maintaining a safe navigational watch; knowledge of BRM principles including allocation, assignment and priority of resources; effective communication; assertiveness and leadership; and obtaining and maintaining situational awareness.

However, the BRM education requires effective communication between crews in the bridge, ship-to-ship, and also ship-to-VTS (Vessel Traffic Services). The BRM also requires leadership skills, and correct decision-making to obtain and maintain situational awareness. The following requirements of 2010 STCW amendment are closely related to the BRM educational training:

a) Use of the IMO standard communication phrases and the use of English in written and oral form. Adequate knowledge of the English language in order to enable the officer to use charts and other nautical publications; to understand meteorological information and message concerning ship's safety and operation; to communicate with other ships, coast stations and VTS centre; and to effectively perform the officer's duties with multilingual crew.

b) Use of leadership and managerial skill: knowledge of shipboard personnel management and training; knowledge and ability to apply effective resource management; and knowledge and ability to apply decision-making and risk assesment; identify and generate options; and evaluation of outcome effectiveness.

c) Plan a voyage and conduct of navigation: voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks, taking into account the following, restricted waters, ice, restricted visibility, traffic separation schemes, and area of extensive tidal effects.

d) Develop emergency and damage control plans and handle

emergency situations: preparation of contingency plans for response to emergencies; ship construction, including damage control; and methods and aids for fire prevention, detection and extinction.

The 2010 STCW requires mariners' competency which is defined in terms of measurable outcomes and emphasizes the relationship in which knowledge, skill and attitude complement each other in learning and development. The essence of the model is that knowledge, ability and motivation are all necessary to prepare for safe voyage. To satisfy the STCW requirements, IMO provides the model course to educate and train Deck officers and Engine officers. For each function of STCW, IMO has provided its model course with the detailed syllabus.

However, the BRM model course is not available, although other model courses for safe navigation are provided by IMO.

Nevertheless, several shipping companies including educational institutions have carried out the BRM training based on their own programs. To provide the consistency among BRM programs, the unified guideline for BRM training is required. This paper suggests a proper direction to improve the current BRM program in Korea.

2.2 BRM Training Program in Korea

Like all of IMO member states, Korea has offered BRM education program focusing on human-related activities in the safe operation of ships and the need to achieve and maintain high standards of safety for the purpose of signifying reduction of maritime casualty(Rothblum, 2002).

This paper refers to BRM course offered by maritime institution in Korea. The domestic BRM education programme was initially designed on the basis of the STCW 2010 amendment(Jeong and Sung, 2011). The BRM course is conducted in a 3-day period and focuses on the harmonized behaviors among ratings, officer, master, and pilot. The course includes both lecture and simulation. The details of the course is shown in Table 1.

3. Analysis of Bridge Resource Management Program

3.1 Questionnaire Design and Survey Method

The questionnaire is designed to quantitatively measure the current BRM education program in Korea. It focuses on the respondents with maritime background and practicing professionals in the maritime academy and industry. It uses the respondent's "sea experience" and "position" or rank as variables. The "observation number" refers to the number of respondents. "Sea

A Study on the Effective Teaching Method for Bridge Resource Management in Korea

Table 1. BRM course outline (Unit: minutes)

Bridge Resource Management Subject	Time	
	Lecture	Practice
Bridge Resource Management - Changing awareness to prevent accident - Realizing about cultural difference - Human error	150	50
Teamwork - The importance of the role and awareness - The necessity of voyage plan monitoring - Bridge team work at different situations	50	
Leadership and Decision Making - Leadership - Leader type and behavior (action) - Decision Making	100	
Communication - The conception of communication - The importance of communicating - The difficulties of communicating - Briefing and debriefing - Objection and accommodation	50	
Voyage Planning - The purpose of voyage planning - The advantage of voyage planning - The section of voyage planning - The procedure of voyage planning	60	50
Simulation - The navigation, anchoring and coming a long side the pier in sea route P/S - Practice to react in fire on ship	280	
Emergency-Psycho reaction stage in emergency situation.	100	

experience” is the quantitative period of respondent’s working period onboard ships measured by month, and “position” is a nominal description of work performed like “maritime educator”, “officer on board ship” and “apprentice officer or cadet”.

The questions are arranged into four groups based on: knowledge and skill; training method, and teaching material used. Group 1, which has seven questions aims to measure the respondent’s understanding of the general BRM principles that relates to education method, subject contents and teaching aids used. Group 2 questions gauge the participant’s attitude related to preventing maritime accidents and how to improve the delivery of BRM subjects. Group 3 questions measure the participant’s perception relating to maritime accident cases. Lastly, Group 4, with six questions, is to know the satisfaction rating of BRM education program items.

The survey used SPSS (Statistical Package for the Social Sciences) program Version 16.0 and Excel 2007-data analysis add-in, such as: Count-if and Frequency in analyzing the collected data.

3.2 Survey Result

This survey was carried out from April till June 2012. Out of 100 questionnaires distributed, 40 questionnaires were gathered from those who worked on board over than 1 year. 60 questionnaires were collected from the senior cadets of a maritime university in Korea. The reliability of the survey was tested by Cronbach’s α (Alpha) and result is presented in the Table 2 below:

Table 2. Survey Reliability Statistics

Cronbach’s Alpha	Cronbach’s Alpha Based on Standardized Items	Number of Items
.938	.958	42

By using SPSS, the author analyzed 45 items with Likert scales and the result is 0.938 which compares to Alpha (α) > 0.5. Therefore, the survey reliability was accepted in statistical science. The level of satisfaction of Group 1, 3, 4 questions is rated using a Likert scale with 5 values: “1” = “very satisfied” to “5” = “very dissatisfied”. Firstly, this paper analyzed Group 1 questions based on sea experience:

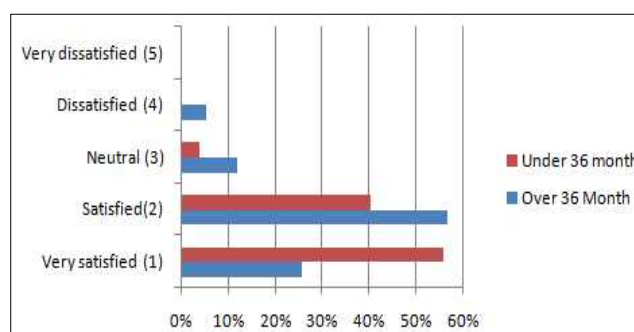


Fig. 1. Satisfaction level according to sea experience.

The Fig. 1 shows the satisfaction level with respect to content, method, time and facility. This question is given to the participants of the two groups, i.e., mariners with sea experience over 36 months and under 36 months. Among the participants who responded “very satisfied”, 56 % are under 36-months while 26 % are over 36-months. Those who responded “satisfied”, 40 % are under 36-months and 57 % are over 36-months.

Next, it analyzed Group 3 questions based on sea experience shown in Fig. 2.

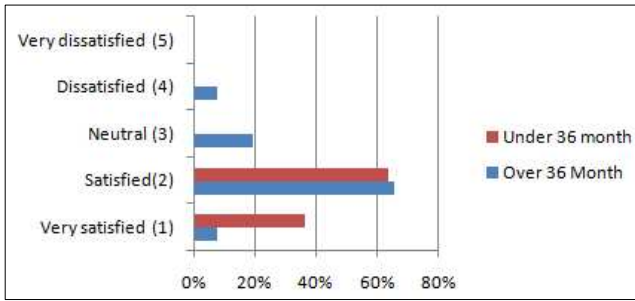


Fig. 2. Maritime accident case study teaching satisfaction.

Fig. 2 shows the number of respondents over 36-months experience is 8% lower than under 36-months experience. The attitude of respondents with experiences between over 36-months and “under 36-months” in the “satisfaction” level is almost the same.

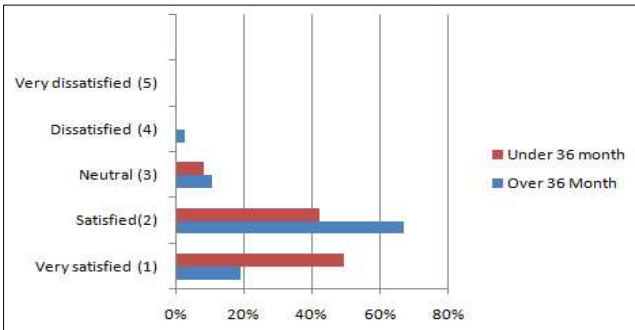


Fig. 3. Satisfaction level for subjects in BRM education program.

Lastly, it analyzed Group 4 questions which are based on sea experience as shown in Fig. 3 where 19% of the respondents with onboard experience over 36 months were “very satisfied” with BRM education program items, while 49% under 36-months experience was “satisfied”.

Analyzing the satisfaction level of participants by maritime experiences as illustrated in Figs. 1, 2 and 3, proved that more than 70% of respondents were “satisfied” with the current BRM education program, content, lecture time and teaching method.

The level of importance for each BRM education item is questionnaire was also surveyed. The question is arranged for the six sub-items in order of importance by allocating “1” as the most important, “2” as the second-most important, until “6” as the least important. The item choices are: Maritime equipment, Communication, Leadership, Teamwork, Simulation and ECDIS (Electronic Chart Display and Information System) practice. The respondent ticks the corresponding number (1 to 6) according to his choice.

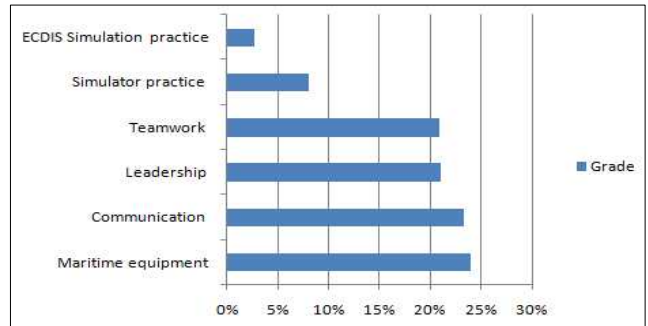


Fig. 4. Statistic of BRM subject important grade.

The questionnaire also evaluated the level of participants’ satisfaction on Maritime Equipment, Communication, Leadership, Teamwork and ECDIS practice. The evaluation shows “Communication” is the first choice, followed by “Leadership” and lastly by “Teamwork”. This paper suggests that the education item with higher importance level needs more lecture time, hence, “communication” should allocated more training time, then “leadership” and least is “teamwork”. Apart from analyzing satisfaction level, the question focuses on the relationship between education items. The paper used interpret regression coefficients to find out the answer for this question and the result is represented in Table 3.

Let β_j denote the population coefficient of the j th regressor (intercept, Position and Sea Experience). Then: Column “Coefficient” gives the least squares estimates of β_j . Column “Standard error” gives the standard errors (i.e. the estimated standard deviation) of the least squares estimates b_j of β_j .

Column “t Stat” gives the computed t-statistic for $H_0: \beta_j = 0$ against $H_a: \beta_j \neq 0$. This is the coefficient divided by the standard error. It is compared to a t with $(n-k)$ degrees of freedom where here $n=100$ and $k=98$.

Column “P-value” gives the p-value for test of $H_0: \beta_j = 0$ against $H_a: \beta_j \neq 0$. This equals the $\Pr\{|t| > t\text{-Stat}\}$ where t is a t-distributed random variable with $n-k$ degrees of freedom and t-Stat is the computed value of the t-statistic given in the previous column. Note that this p-value is for a two-sided test. For a one-sided test divide this p-value by 2 (also checking the sign of the t-Stat). Columns “Lower 95%” and “Upper 95%” values define a 95% confidence interval for β_j . A simple summary of the above output is that the fitted line is:

$$y = \beta_1 + \beta_2 \times 2 + \beta_3 \times 3 + u$$

$$y (\text{Maritime Equipment}) = 4.931 + (-0.966) \times x + 0.000 \times z$$

$$y (\text{Communication}) = 2.026 + 0.241 \times x + (-0.002) \times z$$

Table 3. Interpretation of regression coefficients of group question

BRM's Subject		Coefficients	Standard Error	t Stat	P-value	Lower 95 %	Upper 95 %
Maritime Equipment	Intercept	4.931	1.351	3.650	0.001	2.185	7.677
	Position	-0.966	0.686	-1.407	0.168	-2.360	0.429
	Sea Experience	0.000	0.002	0.122	0.904	-0.004	0.005
Communication	Intercept	2.026	1.202	1.686	0.101	-0.416	4.468
	Position	0.241	0.610	0.394	0.696	-0.999	1.481
	Sea Experience	-0.002	0.002	-1.065	0.294	-0.006	0.002
Leadership	Intercept	2.580	1.289	2.001	0.053	-0.040	5.200
	Position	0.113	0.655	0.173	0.864	-1.217	1.443
	Sea Experience	-0.002	0.002	-0.719	0.477	-0.006	0.003
Teamwork	Intercept	3.344	1.559	2.145	0.039	0.175	6.512
	Position	-0.389	0.792	-0.491	0.627	-1.997	1.220
	Sea Experience	0.000	0.003	0.138	0.891	-0.005	0.006
Simulation	Intercept	2.962	1.167	2.539	0.016	0.591	5.333
	Position	0.815	0.592	1.375	0.178	-0.389	2.019
	Sea Experience	0.002	0.002	0.917	0.366	-0.002	0.006
ECDIS practice	Intercept	5.535	0.962	5.755	0.000	3.581	7.489
	Position	0.064	0.488	0.131	0.897	-0.929	1.056
	Sea Experience	-0.001	0.002	-0.493	0.625	-0.004	0.002

$$y (\text{Leadership}) = 2.580 + 0.113 \times x + (-0.002) \times z$$

$$y (\text{Teamwork}) = 3.344 + (-0.389) \times x + 0.000 \times z$$

$$y (\text{Simulation}) = 2.962 + 0.815 \times x + 0.002 \times z$$

$$y (\text{ECDIS practice}) = 5.535 + 0.064 \times x + (-0.001) \times z$$

The interpret regression coefficient result showed that the respondent's satisfaction affected on Maritime Equipment's satisfaction ($\beta_j = 4.931$, P-value = 0.001), Communication's satisfaction ($\beta_j = 2.026$, P-value = 0.101), Leadership's satisfaction ($\beta_j = 2.580$, P-value = 0.053), Teamwork's satisfaction ($\beta_j = 3.344$, P-value = 0.039), Simulation's satisfaction ($\beta_j = 2.962$, P-value = 0.016), ECDIS practice's satisfaction ($\beta_j = 5.535$, P-value = 0.000).

This survey showed that participants satisfied with the content of the current BRM program. However the respondents expect to focus on the maritime navigation equipments, communication, leadership, teamwork, simulation, and ECDIS practice to prevent maritime accidents. From the survey results, this paper suggested the BRM education method help BRM education program to operate the BRM education program effectively, flexibly.

4. The BRM Improvement Method

The following Figures 1, 2 and 3 show that 70 percentage of respondents satisfied with contemporary BRM education program

but 30 percent of them are dissatisfied. It follows then that there is still 30 % necessity to improve BRM teaching program to draw the student's attention to acquire a accident-free mind-set in maritime world. According to the survey result, t-stat and P-value in Table 3 shows that the education content of BRM course contributed greatly. It does not only satisfied STCW requirements but also suits the students' ability.

However, Table 1 suggests that lecture time was not allocated in a rational way. The total time for "simulation" subject is 280 minutes (33.3 %) and it is about 5-6 times greater than other subject's total time such as: Leadership and decision making, communication, and teamwork. On the other hand, leadership and decision making, communication and teamwork subject are lacking of practice time. According to "Dale's cone of experience"(Edgar, 1969), the human memory depends on "90 % by what they do".

Thus, to upgrade maritime education and training as well as reduce maritime accident, the time for simulation and onboard training should be increased, compared with the lecture time. Concretely, it is required to reduce the time for simulation subject as well as to share the time taken in another subjects. The course recommends that 30 minutes for practice in leadership and decision-making, communication and teamwork subjects. For emergency subjects, time fund will share 50 minutes for lecture and 50 minutes for practice. The course will supply 30 minutes for

practice in leadership and decision making, communication and teamwork subject. For emergency subject, time fund will share 50 minutes for lecturing and 50 minutes for practicing.

Apart from readjusting lecture time, this research seeks a proper direction to improve education method. Figure 2 showed that respondent satisfied with the current maritime accident case study. Referring to the 'Ebbinghaus forgetting' research(Scharter, 2001), which discovered memory decayed as a function of time with the most dramatic forgetting happening soon after the original learning, he showed that the forgetting is nearly flat for vivid or traumatic experiences. It means the practice in education is necessary to increase retention period in terms of memory and to learn the material repetitively rather than to concentrate on it intensely for a short period of time.

Herein, this research suggests that the case study for the past maritime accidents should be included in every subjects and then in group-discussion to analyze maritime accident causes(Yin, 2003). All the case study needs to be designed with the real maritime accident that occurred. Also, lectures also prefer to use multi-media to present accident cases visually with the aid of images, sound and animation.

5. Conclusions

This paper suggests the proper direction to improve the BRM teaching program for cadets and seafarers based on the results of questionnaire survey conducted which is meant to measure the effectiveness of the program. This research surveyed respondents satisfaction related to the contemporary BRM course in Korea.

Although the questionnaire was carried out in a short time and with small seafarer sample, several guidelines were suggested in improving the local BRM training program in line with the requirements of the 2010 STCW amendments.

This paper studies a comprehensive the BRM education program in Korea. Based on the survey, the different steps that should be taken in order to design, implement, evaluate, and ensure the upgrading of a BRM education program have been suggested. More than 70% participants of the survey are satisfied with education program.

However, there is still a need to concentrate more in some subjects, such as: maritime equipment, teamwork and leadership. The survey result also indicates that the case study for real maritime accidents is necessary to recognize the navigation situation clearly and increase the effectiveness of BRM education.

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